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ESD AND HEALTH CARE SYSTEMS:  
SOME STRATEGIC CONSIDERATIONS

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## ESD and Health Care Systems: some strategic considerations

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Proper health care delivery to a growing but aging population is becoming one of the most challenging tasks of our time. It becomes also one of the most complex. Although many tools are at hand, grand designs and implementation systems are mostly lacking. In the industrialized countries, requests for optimal medical care and the demographic evolution towards longer life have led to different health care systems but all of them may be characterized as more or less dysfunctional (see below). In many developing countries, the gaps caused by the lack of health care infrastructure and education and by economic backwardness are becoming increasingly apparent.

On the other hand, the relatively new approach of engineering for solution and optimization of various complex problems, such as energy, infrastructures, transportation, manufacturing or environmental protection *leads us to ask whether the logical and analytical tools developed in complex systems engineering could also be applied to the whole or parts of the health care field.* A brief discussion of that issue is the purpose of this memorandum.

### 1. Health Engineering, Health Systems Engineering: An attempt at definitions

The terms of “Health Engineering” or “Health Systems Engineering” are of relatively recent origin and are poorly or not defined<sup>2</sup>. They cover in fact a large and heterogeneous set of activities, requiring each very different education and experience. In order to know what one talks about, it is therefore mandatory to classify the various lines possibly covered by these general definitions.

#### 1.1 Hospital and health facilities infrastructure, including design, construction, operation and management<sup>3</sup>, for example the multiple uses of digital technology in the planning, operation and maintenance of health facilities<sup>4</sup>

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<sup>1</sup> The author has no first hand knowledge about ESD’s current mission and involvement of its faculty in public health matters but is aware of the desire of ESD to increase its activities in the health sector. His considerations are, however, based on 40 years of experience as professor of immunology at the Universities of Bern (Switzerland) and Navarra (Spain), expert associated to various projects of the World Health Organization, advisor to the Swiss Federal Drug Administration, Advisor and Chairman of various Committees of the Swiss and German Health Ministries 1975-1990.  
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<sup>2</sup> Health Systems Engineering. 2009. [www.Wikipedia.org](http://www.Wikipedia.org)

<sup>3</sup> In the US, this line is covered mostly by the American Society for Health Care Engineering and the American Hospital Association (see 2009 ASHR Education Catalogue

1.2 Health Care Delivery. Under this broad term may be understood education and optimization of work conditions for physicians and paramedical personal, delivery of care to less privileged classes of the population, delivery of care to the elderly, nursing homes etc. It may also encompass delivery of drugs and various medical technologies in an optimal way. Each one of these issues represents a problem in itself, which may require specific solutions but they are also interrelated and would therefore require some complex integrating thinking.

The complexity of each one of these problems has led in most countries to piecemeal studies, with little global integration and even less global action.

1.3 Engineering of medical instruments and gadgets designed to improve health care, e.g. for the elderly

1.4 Engineering of housing, accommodations, transportation (e.g. safer cars) designed for improvement of human health.

1.5 Measures designed for achieving improvement in living conditions and health of some portions of the population (keeping the elderly at home, telemedicine, care for Alzheimer, etc.)

1.6 Impact of environmental engineering on human health

1.7 Impact of engineering food and nutrition on human and animal health

These are only some examples and do not pretend to be exhaustive. While in most developed countries, these issues have been the object of multiple studies, initiatives and projects, they have seldom been considered as a whole or become the object of “global thinking”. Without doubt, however, this is what any responsible government of a large nation or any health-oriented group of nations should do. In the US, a very hopeful new start in this global approach to health care has been made by President Obama’s initiative on Health Care Reform 2009 <sup>4</sup> and the BIG Health Consortium<sup>5</sup>.

As for MIT and peculiarly ESD, who carry a tradition of excellence in the field of engineering research and education they should on the background of the global view of health care problems, choose those issues where the human resources at hand or to be acquired and their engineering skills may exert the most important impact on health care

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<sup>4</sup> White House and HealthCare Reform: [www.whitehouse.gov](http://www.whitehouse.gov)

<sup>5</sup> Big Health Consortium. <http://bighealth.nci.nih.gov>

## 2. Health care in the US: major problems and global view

The US Health Care system<sup>5</sup> is certainly the most expensive in the world (16% of GDP): it may also be one of the best in terms of specific achievements in medical research, diagnosis and therapy in individual medical centers but it ranks very poorly in terms of health care delivery to the general population<sup>6</sup>. It has been estimated that 98'000 Americans and more than one million patients are injured each year as a result of broken health care processes and system failures.

National solutions for health care delivery vary greatly among industrialized countries: they go from state-operated and financed systems to systems based strictly on private insurance. None of the health systems in the world functions satisfactorily: all show some more or less severe degree of dysfunction. A global study of these various systems allows to evaluate in realistic dimensions the advantages and disadvantages of each one: it also permits to propose and enforce adjustments to any specific situation. A number of such comparisons have been done in recent years<sup>6-10</sup>. For any unbiased observer in this field, it is almost unbelievable that the US Health Care system, since the last failed reform in 1993 has been the victim of such benign neglect, not only from the political authorities but from the citizens themselves. Health care delivery is heavily dependent upon cultural, political, institutional and economical conditions. Hence, there is probably no single balanced and optimal solution for everyone. Finding the optimal balance in a given situation of complex and conflicting interests may be one of the more challenging tasks of health care engineering.

The major problems in the US Health System are well identified and acknowledged<sup>6</sup>: a) the rising costs of medical technology and prescription drugs; b) the very excessive administrative costs due to the complex multi-payer system (reaching 34 % among for-profit hospitals!!) ; c) the unnecessary emergency costs of that part of the population which has no access to health insurance; d) the aging of facilities to meet their own needs. The system has no formal structure or organization; health providers are not coordinated.<sup>9-13</sup>.

<sup>5</sup> Health care in the United States. Wikipedia 2009 <http://en.wikipedia.org>

<sup>6</sup> Starfield B. "Is US health really the best in the world". JAMA, 2000; 284: 483-485

<sup>7</sup> World Health Organization. The World Health Report 2000 – Health Systems: Improving performance (Geneva, WHO 2000)

<sup>8</sup> J Landers. Comparing French, US health systems, their changes and their challenges, 2009.

<sup>10</sup> The US health care system: Best in the world or just the most expensive? 2001 Maine University, Bureau of Labor Education

<sup>11</sup> K. Gerencher . Americans down on the US health-care system. 2008. [www.marketwatch.com](http://www.marketwatch.com)

<sup>12</sup> Seshamani M, Roadblocks to Health Care. 2008 Report, Agency for Healthcare Research and Quality, HHS

<sup>13</sup> Lacial JC The case for health engineering, 2008 Motorola

<sup>13</sup> McGlynn EA et al. The quality of health care-delivered to adults in the United States. NEJM, 2003; 348: 2635-2645. [www.xontent.nejm.org](http://www.xontent.nejm.org)

There are gross local and regional, as well as ethnic and socio-economic inequalities in the delivery of health care, of its quality and of its perception by the patients<sup>13</sup>. as well as many roadblocks to efficient health care delivery<sup>12</sup>.

One of the main goals of the health system is to achieve compression of the costs due to the small percentage of sick and disabled old individuals. In 1995-1999, the mean total Medicare spending was \$ 5.8 billion. Of these 84 % was due to 20% of the insured, 1% being responsible for 17% (\$ 98k per person), while on average another 20 % of costs were \$3,000 per person and the other 60% were less than 400 \$ per person<sup>12</sup>.

Solutions to these problems do exist and have been proposed, sometimes in a straight forward and simple form<sup>14</sup>. First, the system must operate according to a public-private partnership philosophy, in which the funding for care should be on the basis of annual or episodic whole of person care rather than on individual piece rates as at present (e.g. Kaiser-Permanente). The whole system must be developed with interoperable technology systems. Second, the public component of the healthcare system would include universal basic health insurance for some special Segments of the population who cannot afford private insurance (unemployed, some seniors, the impoverished). An alternative is to make private insurance mandatory for all but to subsidize people who cannot afford it. Third, the private component would be funded with the aid of tax incentives to encourage most people to take private insurance (aim at 80-90% of the population). This requires a complete overhaul and a strong regulatory frame for the private insurance sector of health care.

There is a large consensus that something has to be done fast to reform the US health care system<sup>15-18</sup> but opinions differ on basic options, such as the number of physicians and health care providers needed to optimize the system<sup>20</sup>. A major national effort is under way to discuss and implement health care reform in the US<sup>15-17</sup>. Many groups and associations have put forward guidelines and ideas<sup>19</sup>.

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<sup>14</sup> P. Yellowlees. How to design a new American healthcare system-3 simple proposals..

[www.articledashboard.com](http://www.articledashboard.com)

<sup>15</sup> White House Forum on Health Reform. [www.healthreform.gov](http://www.healthreform.gov)

<sup>16</sup> Americans speak on health reform: Report on health care community discussions.

[www.whitehouse.gov/healthcare/healthreform/commiunity\\_discussions](http://www.whitehouse.gov/healthcare/healthreform/commiunity_discussions)

<sup>17</sup> Transforming and modernizing America's Health Care Sytem. President Obama's fiscal 2010 budget.[www.whitehouse.gov/omb/fy2010\\_key\\_healthcare/](http://www.whitehouse.gov/omb/fy2010_key_healthcare/)

<sup>18</sup> The Costs of Inaction .[www.healthreform.gov](http://www.healthreform.gov)

<sup>19</sup> Gibbons RJ et al. The American Heart Associaion's 2008 Statement of Principles for Healthcare Reform. *Circulation*, 2008; 118: 2209-2218

<sup>20</sup> Goodman DC, Fisher ES. Physician workforce crisis? Wrong diagnosis, wrong prescription. *NEJM*, 2008; 358: 1658-1661 . [Http//content.nejm.org](http://content.nejm.org)

Among the major principles for such a reform should be:

- All residents of the United States should have meaningful, affordable health coverage and receive affordable, high quality health care
- Preventive benefits should be an essential component of health coverage and appropriate incentives should be built into the health system to that effect
- Race, gender and geographical disparities in health care must be eliminated
- Support of biomedical and health services research should be a national priority

It remains, however, that implementation will require an extraordinary complex set of tasks, which can only be achieved by a coordinated effort of health care providers, patient-based organizations, all kinds of health-related professionals, insurance institutions and political authorities. This would also require the creation of some efficient permanent institution(s) to foster and supervise health care delivery at the national and state levels.

### 3. Complex System Engineering an its relationship to Health Care

The essence of systems engineering is to design and manage complex engineering projects, including logistics, the coordination of different teams, automatic control of machinery and an interdisciplinary approach to complex problems <sup>21</sup>. A complex system as a whole may greatly differ from the sum of its parts' properties. Systems engineering has developed a whole set of tools, including data base management, graphical representation, simulation, conceptual and mathematical modeling. Historically, these tools have been applied primarily to complex industrial production processes, urban management, transportation and infrastructures. Their use in the health field would be a rather new endeavor.

Up to now, systems engineering has essentially devoted its attention to classical fields of engineering such as industrial production processes, transportation and urban problems, logistics, aeronautics etc. For these purposes, Systems Engineering has essentially developed a series of analytical tools based on logic and mathematical analysis, and proposed solutions based on electronic simulation models.

At first glance, similar techniques may be applied to a large number of health care problems, more or less closely related to instrumental engineering (e.g. medical gadgets and instruments, drug delivery chains) to more abstract concepts (balance between institutional and home care, outcome-based medical procedures and

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<sup>21</sup> Systems Engineering. <http://en.wikipedia.org>

<sup>22</sup> Coleman K, Austin BK, Brach C, Wagner EH. Evidence on the Chronic Care Model in the new millennium. Health Affairs, 2009; 28: 75-85 <http://content.healthaffairs.org>

<sup>23</sup> Grossmann J.H. Disruptive innovation in health care: Challenges for engineering.

decisions) . A very powerful idea is also to apply systems engineering techniques to the field of health preventive measures and disease prevention . In some ways, one can certainly construct analogies between human health prevention and “Integrated System Health Engineering and Management (ISHEM)’<sup>24</sup> or “Dependable System Design and Operations” , whereby in that case “health” is oftentimes interpreted as health of the machine ! Various Chronic Care Models (CCM) have been shown to improve health care delivery and outcomes<sup>22,23</sup>.

Health improvement can be considered as an engineering challenge. Once an individual falls ill, the best treatment plan is definitely a highly personal intervention. On the other hand, preventive health measures can be generic and very broadly applied across large groups of people. Those measures are highly predictive of health outcomes and lend themselves to an engineering approach on a large scale.

We can certainly look at the immense amount of data already available to try to “engineer health” by testing, publishing and promoting “best practices” for the maintenance and enhancement of every individual’s health. Let us apply the same engineering tools and methodologies that build complex, reliable systems to maintaining our bodies in top operating capability.

A seminal and comprehensive report on the interaction between systems engineering and health care delivery has been put forward in a joint report by the Institute of Medicine and the National Academy of Engineering (NAE)<sup>26</sup>, chaired by J.H. Grossman<sup>22,26</sup>, who has also provided a very perceptive analysis of the issues facing health care and systems engineering. One of the major obstacles is the “cottage industry” structure of most of the US health care system and the still very patchy electronic data bases<sup>27</sup>. The application of systems engineering principles in improving health care delivery in very specific areas such as hemodialysis, radiation therapy and patient flow modeling has been described<sup>28</sup>. Health engineering is also rapidly becoming an issue in Europe<sup>29</sup>.

<sup>23</sup> Lecal JC The case for health engineering [www.motorola.org](http://www.motorola.org) [www.IEEE2407.org](http://www.IEEE2407.org)

<sup>24</sup> Integrated System Health and Management. 2008. [www.ti.arc.nsa.gov](http://www.ti.arc.nsa.gov).

<sup>25</sup> Building a Better Delivery System. A New Engineering/Health Care Partnership. National Academies Press. – Using systems engineering to improve the health care delivery system`.

<sup>26</sup> Using systems engineering to improve the health care delivery system. Inaterviiv with JH Grossmann. www.

<sup>27</sup> Jha AK et al. Use of electronic health records in U.S. hospitals, NEJM, 2009; 360: 1628-1638 [www.conten.nejm.org](http://www.conten.nejm.org)

<sup>28</sup> Kopach-Konrad R, Lawley M, Criswell M, Hasan I, Chakraborta S, Pekny J, Doebelling BN Applying systems engineering principles in improving health care delivery. J gen Intern Med, 2007; 22: suppl 3: 431-437 [www.springerlink.com](http://www.springerlink.com)

<sup>29</sup> Fuller GW. Public health engineering in European countries. Am J Public Health, 1997,17: 466-9 [www.pubmedcentral.nih.gov](http://www.pubmedcentral.nih.gov)



#### 4 . ESD and Health Care

In its 2009 brochure, ESD includes *Health Care Delivery* as one of its four domains of activities, aside Critical Infrastructures, Extended Enterprises and Energy and Sustainability. The general statements on the application of a “systems view” to health care take a very broad view, including medical training, government regulations and insurance incentives. ESD work should include applying inventory theory and process improvement methods to the operation of hospitals, analysis of medical outcomes (risk/benefit), analysis of costs versus level of service as well as individual rights and needs versus society’s goals and capacities. This seems at first glance a very broad menu, more akin to that of a national health institution.

However, a potentially very significant step taken is the recent association of ESD with the **MIT Center for Biomedical Innovation**<sup>30</sup> and the **BIG Health Consortium**<sup>31</sup>, an extended Web host for defined project action groups. Although these initiatives appear to me for the time being not much more than well-intentioned Web-based declarations of intentions, they may provide a framework in the future to achieve the multidisciplinary forum an regulation tool which will be needed for concrete improvements in health care delivery.

In fact, one of the most remarkable assets of ESD in terms of health-related engineering is its **Age Lab** devoted to promote elderly’s health by various engineering advances and projects. Among the major innovative lines of work of the Age Lab are:

- Driving and personal mobility
- Wellness and self-empowered health
- Independent living and care-giving
- Business strategy and innovation
- Retirement and longevity planning

The Age Lab projects cover many facets of the complex problems arising from aging of the population and such programs deserve much attention and support from ESD, MIT and public authorities.<sup>32-34</sup>

<sup>30</sup> MIT Center for Biomedical Innovation Joins the Engineering Systems Division .  
[www.mit.edu/newsoffice](http://www.mit.edu/newsoffice)

<sup>31</sup> BIG Health Consortium. <https://bighealth.nci.nih.gov/index.php>

<sup>32</sup> Coughlin JF. Invention vs innovation: Technology and the future of aging. *Aging Today* 2006, 27: 3-4. [www.agingtoday.org](http://www.agingtoday.org)

<sup>34</sup> Coughlin JF, Pope JE, Leedle BR. Old age, new technology, and future innovations in disease management and home health care. *Home Health Care Management & Practice*. 2006; 18: 196-207

<sup>35</sup> At MIT’s AgeLab growing old is the new frontier. *Boston Globe*, Feb 23,2009



## 5. Education in Health Care Engineering

In the field of health-related engineering, over 50 colleges and universities offer some undergraduate or graduate programs leading to various degrees such as: Master and/or PhD degrees(e.g. joint Harvard-MIT program on Health Sciences and Technology **HST**<sup>36</sup>) in :

- Biomedical Enterprise
- Biomedical Engineering
- Health Sciences and Technology
- Engineering and Medical Physics
- Medical Sciences
- Radiological Sciences
- Speech and Hearing Bioscience and technology
- Biomedical Informatics
- Clinical Science Training

This very large variety of programs and degrees is somewhat puzzling, at least to a European mind, since it is very likely that the lines of work designed by the degree's description and specification will most probably disappear or considerably evolve within the life time of its bearer.

In all this flurry of health-related engineering study lines, one seems to me glaringly missing, namely *the application of systems engineering skills to the analysis of complex biological or medical systems and diseases*. Biological and medical research is increasingly discovering **complex networks** responsible for specific diseases. If biologists and physicians master various biological tools, they are rarely conversant with the logical and mathematical tools used by systems engineering, which could lead to a better understanding of their biological system. Among the candidates which come most immediately to mind are:

1. Replacement of *insulin-producing pancreas Beta cells by stem cells* and thereby causal cure for type 1 and 2 diabetes, a disease afflicting millions of elderly people, at great cost to society<sup>37,38</sup>. Engineering systems technologies could probably be of great help in predicting, managing and controlling a reconstituted blood sugar-regulating system. A very significant program in this direction is currently under way at the Harvard Stem Cell Institute<sup>39</sup>.

<sup>36</sup> Harvard-MIT Health Sciences and Technology. MIT engineering. <http://web.MIT.edu>

<sup>37</sup> Lumelski N, Blondel O, Laeng P, Velasco I, Ravin R, McKay R. Differentiation of embryonic stem cells to insulin-secreting structures similar to pancreatic islets. *Science*, 2001; 292: 1389-1394

<sup>38</sup> Success in converting stem cells into insulin-producing cells triggers agreement expansion. [www.Medicalnewstoday.com/2005](http://www.Medicalnewstoday.com/2005)

<sup>39</sup> [www.harvardscience.harvard.edu](http://www.harvardscience.harvard.edu)

2. The *immunological system* is the most glaring example of a network system involving various cell types and a multitude of regulating signals. The only way to really understand it and possibly intervene in various dysfunction models is by using tools of complex systems analysis.

3. Neuronal dysfunctions, among which the one causing the greatest problem to society is *Alzheimer's disease*. There too, the analysis of individual cell failure and factors involved, as well as the possibilities of specific intervention at various levels are sufficiently advanced to make an model-based system analysis feasible.

## 6. Preliminary Conclusions

### 6.1 AgeLab

**Age Lab** is a major asset of ESD in the field of health. It has a record that is internationally known, an original and relevant approach to one of the major problems in health care (aging of the population) and a very rational and visionary program. Seen from the outside, however, it does not seem to have enough faculty resources (most of the faculty seems external to ESD and MIT) to implement some of the important aspects of the program. It seems to me that optimization of the Age Lab should be for ESD a priority, the more as this represents a rather unique approach at the national level.

### 6.2 Electronic use and data acquisition in health care

The acquisition of basic data on health care, such as individual electronic medical records, hospital data, cost and outcome analysis is an essential prerequisite for an improvement in health care delivery. The example of a few organizations such as Kaiser Permanente<sup>40,41</sup>, Intermountain Health<sup>45</sup>, the Veterans Administration<sup>43</sup> with their efficient databases demonstrates forcefully the benefits which can be expected in terms of improving health care quality and diminishing the costs. However, general implementation of electronic data bases in the general health system still requires considerable efforts and incentives in terms of standardization, interoperability and implementation. At present, only 25% of physicians use some form of electronic health record and less than 10 % of doctors use a fully operational system encompassing as well information from the totality of health care providers as from the patient himself<sup>44</sup>. Only 1.5 % of US hospitals

<sup>40</sup> Halvorson GC It's time to create an industrial revolution in health care. 2005 . Presentation at World Bank. [www.george.c.halverson](http://www.george.c.halverson). World bank

<sup>41</sup> The Kaiser Way: Clinical systems engineering and systems thinking. 2007 [www.medinnovationblog.blogspot.com](http://www.medinnovationblog.blogspot.com)

<sup>42</sup> Intermountain Healthcare. Wikipedia. [www.en.wikipedia.org](http://www.en.wikipedia.org)

<sup>43</sup> Health Care- Veterans Administration [www.va.gov/health](http://www.va.gov/health)

<sup>44</sup> Robert Wood Johnson Foundation. 2006. Health information technology in the United States: The information base for progress. [www.rwif.org/files/publications/other/EHRReport0609.pdf](http://www.rwif.org/files/publications/other/EHRReport0609.pdf)

have a comprehensive electronic-records system (i.e present in all clinical units) and an additional 7.6% have a basic system (ie. Present in at least one clinical unit). Computerized provider-order entry for medications has been implemented in only 17 % of hospitals. ESD could and should participate in this national effort. It should also be emphasized that electronic record keeping is a prerequisite for going from the “intuitive medicine” to evidence-based medicine, a condition for high quality health delivery<sup>45</sup> and in providing its knowhow in complex systems analysis and database acquisition by a focused effort in that direction. The ambitious goal to computerize America’s health records in five years has been stated in the fiscal year 2010 budget.<sup>17</sup>

### 6.3 Use of complex engineering system methodology for optimization of health care

The know-how gained in analysis and optimization of complex engineering systems should be applied to health care and medical problems, once the required databases have been obtained.

One example may be the complex networks of physicians, nurses, health care providers, hospitals, nursing homes and individual home care in the maintenance, survey and care of *various categories of patients with chronic illness* (e.g. diabetes, heart disease, arthritis) who are responsible for the bulk of health costs. Another is the development and use of *Web search tools for optimizing medical diagnosis and treatment*<sup>46-50</sup>. A third is to achieve the *interoperability* between medical devices and electronic information tools required to achieve patient safety and health care efficiency.<sup>51</sup>

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<sup>45</sup> Evidence-based medicine. Wikipedia

<sup>46</sup> Kahn R, Anderson JE. Improving diabetes care: The model for health care reform. <http://care.diabetesjournals.org>

<sup>47</sup> Giustini D. How Web 2.0 is changing medicine . BMJ, 2006; 333: 1283-1284

<sup>48</sup> Goldman RE, Sanchez-Hernandez M, Ross-Degnan D, Piette JD, Mac Trinacty C, Simon SR. Developing an automated speech-recognition telephone diabetes intervention. It J Quality Health Care, 2008; 20: 264-270 [www.intqhc.oxfordjournal.org](http://www.intqhc.oxfordjournal.org)

<sup>49</sup> Tang H, Kwoon Ng JH. Googling for a diagnosis- use of Google as a diagnostic aid: internet based study . BMJ, 2006; 333: 1143-1145. [www.bmj.com](http://www.bmj.com)

<sup>50</sup> Falagas ME, Pitsouni EI, Latzis G, Pappas G. Comparison of PubMed, Scopus. Web of Science and Google Scholar: strengths and weaknesses. FASEB J, 2008; 22: 338-342

<sup>51</sup> Goldman JM, Whitehead S. Advancing the adoption of medical device “Plug-and-Play” interoperability to improve patient safety and healthcare efficiency,2008 MD PnP Program. CIMIT, National Academies Press

## Annex 1

### **Preliminary conclusions from the White House Forum on Health Reform – March 5, 2009 – [www.healthreform.gov](http://www.healthreform.gov)**

Premiums have grown 4 times faster than wages in the last 8 years – 46 million are uninsured . The greatest threat to America’s fiscal health is not Social Security, although that is a significant challenge and it is not the investments for rescue of the economy; it is the skyrocketing cost of health care. Our inability to reform health care in the past is just one example of how special interests have had their way and the public interest has fallen by the wayside- We can no longer let the perfect be the enemy of the essential. The status quo is the one option, which is not on the table.

- Costs and access are the two areas which need to be prioritized
- Health care costs should reflect their values. Avoid spending on ineffective or excessive treatments. Importance of comparative effectiveness and Health Information Technology (IT) investment. Between 20 and 30% of health care \$ are spent on procedures that do not improve outcomes or value. Perverse incentives are driving utilization. 45 % of Americans receive care that is not supported by evidence.
- Need for investment in prevention
- The current malpractice system is a contributing factor to high costs due to defensive medicine
- Disproportionate amount of funds spent at the end of life. Need for education and palliative medicine
- Unfairness of exclusions for preexisting conditions
- Need for increased transparency in costs, insurance plans and coverage
- Lack of consensus about the effectiveness of competition to lower costs
- Promoting prevention and wellness to reduce costs; the overwhelming majority of health care \$ is spent providing care to a small minority of people
- The health delivery system needs to move towards evidence-based medicine that focuses on improving quality and outcomes rather than paying for volume. Providers should be paid by improving health outcomes rather than volumes.
- Cut paperwork and processes that impose costs without improving treatment.
- Pay attention to the incentives any system provides for health care providers and ensure that the system promotes efficient, results-oriented behavior.
- The most important is to drive down costs on the private side and on the public side. Is there to be a private (insurance) and a public (Medicare, Medicaid or other) option? If we do not address costs, we will not get this done!
- The idea that a patient and a physician make the health care decisions that affect them is something we need to protect.
- Problem of doctors: not enough incentives for generalists; costs of malpractice suits; fair reimbursement in proportion to other providers.

- Data and evidence have to drive the reform process; differences from state to state: learn from the others.
- Nurses education and recruitment are essential to health care reform
- Is it possible to get along with cutting costs and redistributing the existing money or do we have to find new source(s) of funding?
- In the US everyone is paying \$900 p.a. for cover the costs of emergency room treatment for uninsured people

Need to balance short-term costs versus long term costs. Nothing is harder in politics than doing something now that costs money in order to gain benefits 20 years from now. It's the single hardest thing to do in politics, and that's part of the reason why health care reform has consistently broken down. (Obama)

## Annex 2

# Steps Towards Health Engineering

- **Listing Treatment Costs, Options** → **Promote Value of Prevention**
- **Guidelines for Treatment** → **Guidelines for Prevention**
- **Massive Investments on Devices** → **Invest in Public Health**
- **Paying for Performance** → **Paying for Healthy Living**
- **Personalized Pharmaceuticals** → **Personalized Nutrition**
- **Networking Medical Records** → **Networking Health Knowledge**
- **Postponing Death at the End** → **Enhance Life, Shorten Death**